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Taxonomic Paper

Checklist of bees (*Apoidea*) from a private conservation property in west-central Montana

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Abstract

Background

Here we present preliminary results from the first three years of a long-term bee survey conducted at a 3,840-ha private conservation property in the northern Sapphire Mountains and Bitterroot River Valley, and a pilot study at an associated 80-ha property in the Swan River Valley, Missoula County, Montana, USA. The survey includes hand-net, bowl-trap, and blue-vane trap collections. The resulting checklist comprises 229 bee species and morphospecies within 5 families, 38 genera and 91 subgenera. Of the total species in the list, 34 of them represent first state records Montana. This survey expands the number of bee species recorded in Montana to 366. Included in these species is *Megachile (Eutricharaea)*) *apicalis* Spinola, showing a range expansion for this introduced bee.

New information

We present new distributional records for 34 bee species, including *Megachile (Eutricharaea) apicalis* Spinola, an introduced bee that was discovered to be resident in North America in 1984 in Santa Barbara County, California. This species has since

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expanded its range in the across the west, but had not been previously recorded in Montana.

Keywords

Hymenoptera, biodiversity, pollinator, native species, invasive species, adventive, range expansion, introduced, *Megachile apicalis*, North America, Intermountain West

Introduction

Wild bees play a vital role as pollinators in both agricultural and natural systems, and may be important to the success of habitat restoration projects (Menz et al. 2011, Williams 2011). Work has been done to document bee faunas of some western regions of North America, including Colorado (Scott et al. 2011), the Columbia Basin (Tepedino and Griswold 1995), north-central Washington (Wilson et al. 2010), and some US national parks and monuments (e.g. Messinger and Griswold 2002); but there are few large-scale bee surveys from Montana.

Reported here is the bee species list from the first three years of a long-term bee monitoring study we initiated in 2013 at MPG Ranch, a privately-owned conservation property in the northern Bitterroot Valley and Sapphire Mountains, and a pilot study from MPG North, an associated property in the Swan Valley. Both properties are in Missoula County of west-central Montana. A purpose of this study is to inventory the bee fauna on the properties.

Materials and methods

Study Site

The 3,840 hectare MPG Ranch is a privately-owned conservation property in west-central Montana, in the Bitterroot River Valley and Sapphire Mountains of Missoula County (Fig. 1). Elevations range from 975m at the valley floor along the Bitterroot River, to 1860m on Mount Baldy, its highest point. The region has a mild, semi-arid climate with cool, moist winters and warm, dry summers. Mean precipitation ranges from 300mm at the valley floor to 350mm on mountain summits; most precipitation occurs in the winter as snow. Mean temperatures for the nearby town of Stevensville range from -3.6°C in December to 20.0°C in July.

For over a century prior to 2009, this property had been managed for livestock and agricultural crop production. During that time, most of the lower elevation grasslands were replaced with irrigated crops or introduced forage grasses. These areas are now out of production and undergoing restoration treatments to return them to a more natural state. Livestock has also been removed from the property as part of the restoration effort, and

native ungulates (elk, mule deer, and whitetail deer) currently comprise the majority of vertebrate grazers. Habitats on the property include riparian bottomlands, dry open forests, mid-elevation sagebrush steppe and grasslands, montane grasslands, and montane mixed-conifer forest.

Figure 1.
Map of Montana and surrounding states with Missoula County boundary and property locations marked.

The MPG North, an associated 81 hectare conservation property separated from MPG Ranch by over 100 kilometers, is located in the Swan River Valley, also in Missoula County (Fig. 1), at an elevation of 1200m. The climate in the Swan River Valley is cooler and wetter than the Bitterroot River Valley. At the nearby town of Seeley Lake, mean temperatures range from -6.1°C in December to 17.5°C in July, and mean annual preciptiation is 530mm. MPG North's habitat consists of mixed-conifer forest and clearings, and some small wetlands.

Collection Methods

We captured bees from MPG Ranch using the protocol outlined in *A Standardized Method for Monitoring Bee Populations: The Bee Inventory (BI) Plot* (LeBuhn et al. 2003), modified by reducing the amount of time spent netting from 60 minutes to 30 minutes. We used 24 plots that had been chosen for a larger, multi-organism surveying effort occurring on the property. These 24 sampling plots were placed along an elevational gradient, from approximately 975m elevation to 1850m elevation. At each location we laid out two 50m transects, intersecting at 25m, creating an "X". We deployed 21, 3.25oz Solo brand plastic cups (Solo brand stock number PB6-0099) filled with soapy water at each sampling plot and placed them about 5m apart along the transects. Bowls were spray-painted fluorescent

blue, fluorescent yellow, or left white. Seven bowls of each of the three colors were used at each site. With the exception of the first sampling round, we placed traps out at all sampling plots on the same day by 9am and collected the contents after 3pm, providing a snapshot of the bee species composition for that day. We seived bowl-trapped bees in the field and transferred them into 4oz Whirl-Pak bags with 70% isopropanol. We kept these samples refrigerated until shipment to the USDA-ARS Pollinating Insects Research Unit in Logan, UT, for identification. A total of 30 minutes of netting occurred at each site on each collection day in 2013 and 2015, when time and field staff availability permitted. Netting took place on bowl-trapping days or the following day, and was limited to a 100m radius of plot center. Samplers netted bees throughout the plot and attempted to sample from as many different floral resources as possible within the time frame. Netted bees were dispatched with ethyl acetate and kept frozen in labeled collection tubes until processed.

We sampled every 2-4 weeks throughout as much of the field season as possible to capture as much of the bee fauna as we could. We sampled each of the plots five times in 2013 (June 10-17, July 1, July 22, August 12, and September 9), seven times in 2014 (May 1, May 15, June 12, July 10, July 31, August 28, and September 17), and nine times in 2015 (April 21, May 4, May 18, June 8, June 29, July 20, August 10, September 1, and September 23).

Collecting events at MPG North were part of a pilot study and consisted of a small number of blue vane trap collections and some hand-netting in 2014 and 2015. Bee species caught at MPG North are included in this species checklist.

Species accumulation estimates were determined by using EstimateS (Colwell 2013).

Species Identification

Bees were identified by Skyler Burrows with help from Harold Ikerd, Zachary Portman, Michael Orr, and Terry Griswold. Family, genus, and subgenus classifications follow Michener 2007 except in the some of the *Lasioglossum* subgenera (which follow Gibbs et al. 2012). Species determinations were made using the following taxonomic keys: Colletidae (Snelling 1966a, Snelling 1966b, Snelling 1970, Stephen 1954), Andrenidae (Bouseman and LaBerge 1978, LaBerge and Bouseman 1970, LaBerge 1969, LaBerge 1973, LaBerge and Ribble 1975, LaBerge 1977, LaBerge 1980, LaBerge 1985, LaBerge 1986, LaBerge 1989, Ribble 1967, Ribble 1974, Thorp 1969, Timberlake 1956, Timberlake 1960) Halictidae (Dumesh and Sheffield 2012, McGinley 1986, McGinley 2003, Roberts 1972, Roberts 1973), Megachilidae (Baker 1975, Gonzalez and Griswold 2013, Grigarick and Stange 1968, Hurd and Michener 1955, Michener 1938a, Michener 1938b, Michener 1939, Hurd 1958, Michener 1947, Sandhouse 1939, Sheffield et al. 2011), Apidae (Brumley 1965, Daly 1973, Koch et al. 2012, Hurd and Linsley 1951, LaBerge 1956a, LaBerge 1956b, LaBerge 1961, Laberge 1963, Rightmyer 2008, Sipes 2001, Thorp and Horning 1983, Timberlake 1969). In addition, reference specimens from the U.S. National Pollinating Insect Collection were used for species verification and identification.

Bees that could be morphologically distinguished from each other but lacked taxonomic literature to determine species level were separated into morphospecies and given alphanumeric titles. When male and female morphospecies could not be associated, male morphospecies were given letters (e.g *Nomada* sp. A) and female morphospecies were given numbers (eg. *Lasioglossum* sp. 01). We only included the gender with the larger number of morphospecies in our species counts to avoid falsely inflating the number of species.

Bee specimens were pinned and labeled with location information, date, collection method, and collector name. Except for two synoptic sets of voucher specimens that are kept at MPG Ranch, specimens are deposited in the U.S. National Pollinating Insect Collection at Logan, Utah.

Lasioglossum bees in the subgenus *Dialictus* were identified only to subgenus due to the difficulty in distinguishing between *Dialictus* species and the lack of comprehensive keys for the western United States. Species in the genus *Sphecodes* were also only identified to genus level due to the lack of available taxonomic literature for the area.

Range

Species ranges were determined using Global Biodiversity Information Facility (GBIF), DiscoverLife.org (Ascher and Pickering 2016), and U.S. National Pollinating Insects databases in order to determine how many species records were new to the state of Montana.

Checklist

Family Colletidae

Colletes consors **subsp. *consors* Cresson 1868**

Colletes phaceliae **Cockerell 1906**

Colletes fulgidus **subsp. *fulgidus* Swenk 1904**

Colletes kincaidii **Cockerell 1898**

Hylaeus **(*Hylaeus*) *annulatus*** **(Linnaeus 1758)**

Hylaeus **(*Hylaeus*) *conspicuus*** **(Metz 1911)**

Hylaeus (*Hylaeus*) *mesillae* (Cockerell 1896)

Hylaeus (*Paraprosopis*) *coloradensis* (Cockerell 1896)

Hylaeus (*Paraprosopis*) *wootoni* (Cockerell 1896)

Hylaeus (*Prosopis*) *modestus* subsp. *citrinifrons* (Cockerell 1896)

Family Andrenidae

Andrena (*Andrena*) *milwaukeensis* Graenicher 1903

Andrena (*Andrena*) *schuhi* LaBerge 1980

Notes: New species record for Montana

Andrena (*Andrena*) *thaspii* Graenicher 1903

Andrena (*Andrena*) *vicinoides* Viereck 1904

Andrena (*Andrena*) sp. A

Andrena (*Diandrena*) *evoluta* Linsley & MacSwain 1961

Notes: New species record for Montana

Andrena (*Euandrena*) *astragali* Viereck & Cockerell 1914

Andrena (*Euandrena*) *lawrencei* Viereck & Cockerell 1914

Andrena (*Euandrena*) *nigrihirta* (Ashmead 1890)

Andrena (*Euandrena*) *nigrocaerulea* Cockerell 1897

Andrena (*Holandrena*) *cressonii* Robertson 1891

Andrena (*Leucandrena*) *barbilabris* (Kirby 1802)

Andrena (*Melandrena*) *nivalis* Smith 1853

Andrena* (*Melandrena*) *transnigra **Viereck 1904**

Andrena* (*Melandrena*) *vicina **Smith 1853**

Andrena* (*Micrandrena*) *chlorogaster **Viereck 1904**

Notes: New species record for Montana

Andrena* (*Micrandrena*) *illinoiensis **Robertson 1891**

Andrena* (*Micrandrena*) *melanochroa **Cockerell 1898**

Notes: New species record for Montana

Andrena* (*Micrandrena*) *microchlora **Cockerell 1922**

Andrena* (*Micrandrena*) *piperi **Viereck 1904**

Notes: New species record for Montana

Andrena* (*Micrandrena*) *cf. robinsoni **Lanham 1987**

Andrena* (*Plastandrena*) *crataegi **Robertson 1893**

Andrena* (*Plastandrena*) *prunorum **Cockerell 1896**

Andrena* (*Scaphandrena*) *merriami **Cockerell 1901**

Andrena* (*Scaphandrena*) *scurra **Viereck 1904**

Andrena* (*Scaphandrena*) *sladeni **Viereck 1924**

Notes: New species record for Montana

Andrena* (*Simandrena*) *angustitarsata **Viereck 1904**

Andrena* (*Simandrena*) *pallidifovea **(Viereck 1904)**

Andrena* (*Thysandrena*) *candida **Smith 1879**

Andrena* (*Thysandrena*) *medionitens Cockerell 1902

Andrena* (*Thysandrena*) *w-scripta Viereck 1904

Andrena* (*Trachandrena*) *amphibola (Viereck 1904)

Andrena* (*Trachandrena*) *cupreotincta Cockerell 1901

Andrena* (*Trachandrena*) *forbesii Robertson 1891

Andrena* (*Trachandrena*) *miranda Smith 1879

Andrena* (*Trachandrena*) *salicifloris Cockerell 1897

Andrena* (*Tylandrena*) *subtilis Smith 1879

Calliopsis xenus (Rozen 1958)

Notes: New species record for Montana

Panurginus atriceps (Cresson 1878)

Panurginus sp. 01

Perdita* (*Perdita*) *fallax Cockerell 1896

Perdita* (*Perdita*) *swenki Crawford 1915

Notes: New species record for Montana

Perdita* (*Pygoperdita*) *wyomingensis subsp. ***segona*** Timberlake 1956

Pseudopanurgus didirupa (Cockerell 1908)

Notes: New species record for Montana

Family Halictidae

Agapostemon* (*Agapostemon*) *obliquus (Provancher 1888)

Notes: New species record for Montana

Agapostemon* (*Agapostemon*) *texanus Cresson 1872

Agapostemon* (*Agapostemon*) *virescens (Fabricius 1775)

Dufourea holocyanea (Cockerell 1925)

Dufourea maura (Cresson 1878)

Dufourea trochantera Bohart 1948

Halictus* (*Nealictus*) *farinosus Smith 1853

Halictus* (*Odontalictus*) *ligatus Say 1837

Halictus* (*Protohalictus*) *rubicundus (Christ 1791)

Halictus* (*Seladonia*) *confusus Smith 1853

Halictus* (*Seladonia*) *tripartitus Cockerell 1895

***Lasioglossum* (*Dialictus*) sp.**

Lasioglossum* (*Hemihalictus*) *glabriventre (Crawford 1907)

Lasioglossum* (*Hemihalictus*) *inconditum (Cockerell 1916)

Lasioglossum* (*Hemihalictus*) *kincaidii (Cockerell 1898)

Notes: New species record for Montana

Lasioglossum* (*Hemihalictus*) *ovaliceps (Cockerell 1898)

Notes: New species record for Montana

Lasioglossum* (*Hemihalictus*) *ruficorne (Crawford 1907)

Notes: New species record for Montana

***Lasioglossum* (*Hemihalictus*) sp. 1**

***Lasioglossum* (*Hemihalictus*) sp. 2**

Lasioglossum (*Hemihalictus*) sp. 3

Lasioglossum (*Hemihalictus*) sp. 4

Lasioglossum (*Lasioglossum*) *anhypops* McGinley 1986

Lasioglossum (*Lasioglossum*) *athabascense* (Sandhouse 1933)

Lasioglossum (*Lasioglossum*) *egregium* (Vachal 1904)

Lasioglossum (*Lasioglossum*) *paraforbesii* McGinley 1986

Lasioglossum (*Lasioglossum*) *sisymbrii* (Cockerell 1895)

Lasioglossum (*Lasioglossum*) *trizonatum* (Cresson 1874)

Lasioglossum (*Lasioglossum*) *zonulum* (Smith 1848)

Lasioglossum (*Sphecodogastra*) *cooleyi* (Crawford 1906)

Lasioglossum (*Sphecodogastra*) *lusoria* (Cresson 1872)

Sphecodes sp.

Family Megachilidae

Anthidium (*Anthidium*) *atrifrons* Cresson 1868

Anthidium (*Anthidium*) *mormonum* Cresson 1878

Anthidium (*Anthidium*) *utahense* Swenk 1914

Ashmeadiella (*Ashmeadiella*) *bucconis* (Say 1837)

Ashmeadiella (*Ashmeadiella*) *cactorum* (Cockerell 1897)

Ashmeadiella (*Ashmeadiella*) *californica* (Ashmead 1897)

Notes: New species record for Montana

Ashmeadiella* (*Ashmeadiella*) *cubiceps (Cresson 1879)

Notes: New species record for Montana

Atoposmia* (*Atoposmia*) *elongata (Michener 1936)

Chelostoma* (*Chelostoma*) *minutum Crawford 1916

Notes: New species record for Montana

Coelioxys* (*Boreocoelioxys*) *banksi Crawford 1914

Coelioxys* (*Boreocoelioxys*) *moesta Cresson 1864

Coelioxys* (*Boreocoelioxys*) *octodentata Say 1824

Coelioxys* (*Boreocoelioxys*) *rufitarsis Smith 1854

Coelioxys* (*Cyrtocoelioxys*) *modesta Smith 1854

Coelioxys* (*Xerocoelioxys*) *edita Cresson 1872

Notes: New species record for Montana

Coelioxys* (*Xerocoelioxys*) *grindeliae Cockerell 1900

Dianthidium* (*Dianthidium*) *curvatum (Smith 1854)

Dianthidium* (*Dianthidium*) *pudicum (Cresson 1879)

Dianthidium* (*Dianthidium*) *subparvum Swenk 1914

Dianthidium* (*Dianthidium*) *ulkei (Cresson 1878)

Dioxys pomonae Cockerell 1910

Notes: New species record for Montana

Heriades* (*Neotrypetes*) *carinatus Cresson 1864

Heriades* (*Neotrypetes*) *variolosus (Cresson 1872)

Hoplitis* (*Alcidamea*) *grinnelli Cockerell 1910

Notes: New species record for Montana

Hoplitis* (*Alcidamea*) *pilosifrons (Cresson 1864)

Hoplitis* (*Alcidamea*) *producta (Cresson 1864)

Hoplitis* (*Alcidamea*) *sambuci Titus 1904

Notes: New species record for Montana

Hoplitis* (*Cyrtosmia*) *hypocrita (Cockerell 1906)

Hoplitis* (*Monumetha*) *albifrons (Kirby 1837)

Hoplitis* (*Monumetha*) *fulgida subsp. ***fulgida*** (Cresson 1864)

Megachile* (*Argyropile*) *parallela Smith 1853

Megachile* (*Chelostomoides*) *angelarum Cockerell 1902

Notes: New species record for Montana

Megachile* (*Eutricharaea*) *apicalis Spinola 1808

Notes: New species record for Montana

Megachile* (*Eutricharaea*) *rotundata (Fabricius 1793)

Megachile* (*Litomegachile*) *brevis Say 1837

Megachile* (*Litomegachile*) *coquilletti Cockerell 1915

Notes: New species record for Montana

Megachile* (*Litomegachile*) *lippiae Cockerell 1900

Megachile* (*Litomegachile*) *onobrychidis Cockerell 1905

Megachile* (*Megachile*) *lapponica Thomson 1872

Megachile* (*Megachile*) *montivaga Cresson 1878

Megachile* (*Megachile*) *relativa Cresson 1878

Megachile* (*Megachiloides*) *pascoensis Mitchell 1934

Megachile* (*Sayapis*) *fidelis Cresson 1878

Megachile* (*Sayapis*) *pugnata Say 1837

Megachile* (*Xanthosarus*) *melanophaea Smith 1853

Megachile* (*Xanthosarus*) *perihirta Cockerell 1898

Osmia* (*Acanthosmioides*) *integra Cresson 1878

Osmia* (*Acanthosmioides*) *longula Cresson 1864

Osmia* (*Cephalosmia*) *californica Cresson 1864

Osmia* (*Cephalosmia*) *marginipennis Cresson 1878

Osmia* (*Cephalosmia*) *montana subsp. ***montana*** Cresson 1864

Osmia* (*Helicosmia*) *coloradensis Cresson 1878

Osmia* (*Melanosmia*) *albolateralis Cockerell 1906

Osmia* (*Melanosmia*) *atrocyanea Cockerell 1897

Osmia* (*Melanosmia*) *austromaritima Michener 1936

Notes: New species record for Montana

Osmia* (*Melanosmia*) *brevis Cresson 1864

Osmia* (*Melanosmia*) *bruneri Cockerell 1897

Osmia (*Melanosmia*) *calla* Cockerell 1897

Osmia (*Melanosmia*) *cyaneonitens* Cockerell 1906

Osmia (*Melanosmia*) *densa* Cresson 1864

Osmia (*Melanosmia*) *ednae* Cockerell 1907

Osmia (*Melanosmia*) *juxta* Cresson 1864

Osmia (*Melanosmia*) *kincaidii* Cockerell 1897

Notes: New species record for Montana

Osmia (*Melanosmia*) *melanopleura* Cockerell 1916

Notes: New species record for Montana

Osmia (*Melanosmia*) *paradisica* Sandhouse 1924

Osmia (*Melanosmia*) *proxima* Cresson 1864

Osmia (*Melanosmia*) *pusilla* Cresson 1864

Osmia (*Melanosmia*) *trevoris* Cockerell 1897

Osmia (*Melanosmia*) *tristella* Cockerell 1897

Osmia (*Mystacosmia*) *nemoris* Sandhouse 1924

Osmia (*Osmia*) *lignaria* subsp. *propinqua* Cresson 1864

Stelis (*Stelis*) aff. *Ashmeadiellae* Timberlake 1941

Stelis (*Stelis*) aff. *holocyanea* (Cockerell 1925)

Stelis (*Stelis*) *lateralis* Cresson 1864

Stelis (*Stelis*) *montana* Cresson 1864

***Stelis* (*Stelis*) sp. 01**

Family Apidae

***Anthophora* (*Clisodon*) *terminalis* Cresson 1869**

***Anthophora* (*Lophanthophora*) *pacifica* Cresson 1878**

Notes: New species record for Montana

***Anthophora* (*Lophanthophora*) *porterae* Cockerell 1900**

***Anthophora* (*Lophanthophora*) *ursina* Cresson 1869**

***Anthophora* (*Melea*) *bomboides* Kirby 1838**

***Anthophora* (*Melea*) *occidentalis* Cresson 1869**

***Anthophora* (*Mystacanthophora*) *urbana* Cresson 1878**

***Anthophora* (*Mystacanthophora*) *walshii* Cresson 1869**

Notes: New species record for Montana

***Apis mellifera* Linnaeus 1758**

***Bombus* (*Bombias*) *nevadensis* Cresson 1874**

***Bombus* (*Bombus*) *occidentalis* Greene 1858**

***Bombus* (*Cullumanobombus*) *rufocinctus* Cresson 1863**

***Bombus* (*Fervidobombus*) *californicus* Smith 1854**

***Bombus* (*Fervidobombus*) *fervidus* (Fabricius 1798)**

***Bombus* (*Psithyrus*) *fernaldae* (Franklin 1911)**

***Bombus* (*Psithyrus*) *insularis* (Smith 1861)**

Bombus (*Pyrobombus*) *bifarius* Cresson 1878

Bombus (*Pyrobombus*) *centralis* Cresson 1864

Bombus (*Pyrobombus*) *flavifrons* Cresson 1863

Bombus (*Pyrobombus*) *huntii* Greene 1860

Bombus (*Pyrobombus*) *mixtus* Cresson 1878

Bombus (*Pyrobombus*) *vagans* Smith 1854

Bombus (*Subterraneobombus*) *appositus* Cresson 1878

Ceratina (*Zadontomerus*) *acantha* Provancher 1895

Notes: New species record for Montana

Ceratina (*Zadontomerus*) *nanula* Cockerell 1897

Ceratina (*Zadontomerus*) *neomexicana* Cockerell 1901

Diadasia diminuta (Cresson 1878)

Epeolus aff. *americanus* (Cresson 1878)

Epeolus compactus Cresson 1878

Epeolus minimus (Robertson 1902)

Notes: New species record for Montana

Epeolus sp. 01

Eucera (*Synhalonia*) *edwardsii* (Cresson 1878)

Eucera (*Synhalonia*) *frater* subsp. *lata* (Provancher 1888)

Eucera (*Synhalonia*) *fulvitarsis* (Cresson 1878)

Eucera* (*Synhalonia*) *hurdi (Timberlake 1969)

Notes: New species record for Montana

Habropoda cineraria (Smith 1879)

Melecta* (*Melecta*) *pacifica Cresson 1878

Melecta* (*Melecta*) *separata Cresson 1879

Melecta* (*Melecta*) *thoracica Cresson 1875

Notes: New species record for Montana

Melissodes* (*Callimelissodes*) *composita Tucker 1909

Melissodes* (*Callimelissodes*) *lupina Cresson 1878

***Melissodes* (*Callimelissodes*) sp. 1**

Melissodes* (*Eumelissodes*) *agilis Cresson 1878

Melissodes* (*Eumelissodes*) nr. *microsticta Cockerell 1905

***Melissodes* (*Eumelissodes*) sp. 2**

Melissodes* (*Heliomelissodes*) *rivalis Cresson 1872

Neopasites* (*Neopasites*) *fulviventris (Cresson 1873)

Notes: New species record for Montana

***Nomada* sp. 01**

***Nomada* sp. 02**

***Nomada* sp. 03**

***Nomada* sp. 04**

Nomada sp. 05

Nomada sp. 06

Nomada sp. 07

Nomada sp. 08

Nomada sp. 09

Nomada sp. 10

Nomada sp. 11

Nomada sp. 12

Nomada sp. A

Nomada sp. B

Nomada sp. C

Nomada sp. D

Nomada sp. E

Nomada sp. F

Nomada sp. G

Nomada sp. H

Nomada sp. I

Nomada sp. J

Nomada sp. K

***Nomada* sp. L**

***Nomada* sp. M**

***Nomada* sp. N**

***Nomada* sp. O**

***Nomada scita* Cresson 1878**

***Triepeolus heterurus* (Cockerell & Sandhouse 1924)**

Notes: New species record for Montana

***Triepeolus* aff. *micropygius* Robertson 1903**

***Triepeolus paenepectoralis* (Viereck 1905)**

***Triepeolus* sp. 01**

***Xeromelecta* (*Melectomorpha*) *californica* (Cresson 1878)**

Analysis

Between 2013 and 2015 we collected a total of 64,747 bees representing 229 species and morphospecies across 38 genera in 5 bee families (Suppl. material 1). We had a total of 558 collection events (unique combinations of site and collection date). The number of species we collected is near the number of species we would expect to find in our study area based on species accumulation estimates, which predict the number of bee species in the area to be 255 (Fig. 2). Net collections yielded a total of 110 species, only three of which were species not also collected by pantraps. This number is lower than would be expected based on previous studies showing from 23% and 53% of the bee species collected by net to be unique when compared to pantraps (Grundel et al. 2011, Roulston et al. 2007, Wilson et al. 2008). This may be due to the reduced net collection time period (30 minutes instead of 60 minutes). In addition, many of the net collectors had no prior experience with insect collecting. Increased collection periods and improved collector training could raise the number of unique net collected species.

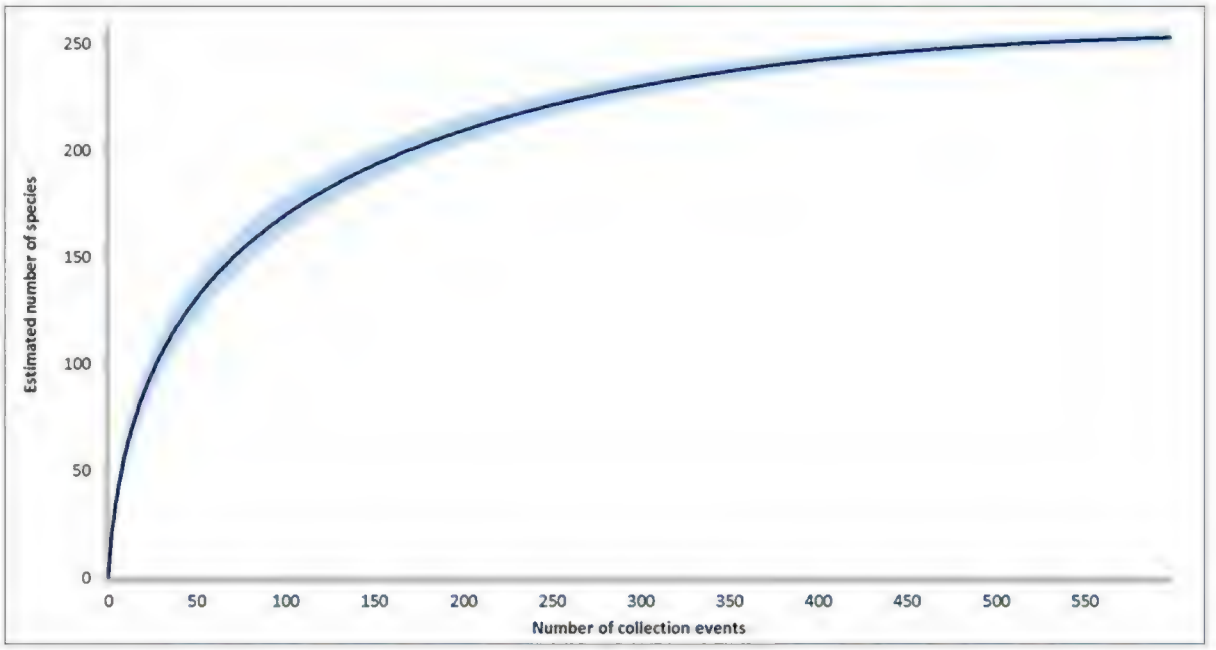

Figure 2.

Species accumulation curve generated for bee species sampled in 558 collection events between 2013 and 2015. Species estimates were generated using EstimateS. The blue line represents the mean species accumulation, and the light blue shaded area represents the upper and lower bound of 95% confidence interval for species estimate.

Discussion

Prior to our investigation, the number of known wild bee species in Montana was 337. Our study increases this number to a total of 366. This result may not be unexpected since Montana is largely rural and there have been few large scale bee inventories in the state. Fewer than 1200 collected bee specimens have been reported each year in Montana prior to 2013 (GBIF 2016, U. S. National Pollinating Insects Database 2016). Our species list is relevant to other areas within the Montana Valley and Foothill Prairies Ecoregion (Taylor 2012), but may not reflect bee species present in other ecoregions in Montana, especially the Northwestern Great Plains and Northwestern Glaciated Plains Ecoregions. Investigations in the sparsely populated central and eastern portions of Montana may yield more species to a state bee species checklist.

Megachile apicalis

Megachile apicalis is an Old World species in the subgenus *Eutricharaea*. Although there are North American records for *M. apicalis* prior to 1932, no established populations were recorded until 1984, when resident populations were documented in Santa Barbara County, CA (Cooper 1984). Subsquent collections showed that the species had expanded its range to Oregon, Washington, and British Columbia, Canada, along with its most common floral host, *Centaurea solstitialis* (Barthell et al. 2001, McIver et al. 2009, Sheffield et al. 2011), a widespread, introduced weed that invades rangelands in the western United States. There is evidence for a positive link between the spread of non-native weeds and the presence of non-native bees (Hanley and Goulson 2003). *Megachile apicalis* has a

strong association with *C. solstitialis* and some researchers have suggested that these two Old World species, along with *Apis mellifera*, form an invasive mutualism (Barthell et al. 2001, McIver et al. 2009), in which each of the three species within the mutualism benefits from the presence of, and encourages the spread of the other species within the mutualism. Our collections are the first documentation of *M. apicalis* in Montana, indicating further range expansion of this adventive bee. *Centaurea stoebe*, a close relative of *C. solstitialis*, is a problematic weed species throughout MPG Ranch and Montana. *Megachile apicalis* captures increase in late summer/early autumn, when *Centaurea stoebe* bloom intensity peaks (MPG Ranch unpublished data), suggesting that *M. apicalis* may be preferentially using this *Centaurea* species in our area. Additionally, *M. apicalis* appears to be integrated throughout the MPG Ranch, since we have found *M. apicalis* at most of our sampling locations.

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Author contributions

Kuhlman initiated the project, conducted the surveys, and prepared specimens for shipment. Burrows processed, identified, and archived all the specimens. Both authors participated in writing this manuscript.

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Supplementary material

Suppl. material 1: MPG species with male and female counts

Authors: Burrows, S.J. & Kuhlman M.
Data type: Occurence
Brief description: MPG species list with number of males and females of each species collected from 2013-2015.
Filename: MPG species with male and female counts.xlsx - Download file (19.86 kb)